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ABSTRACT

To help South Dakota develop new measures of school district fiscal capacity (besides assessed value per pupil) to use in its state school aid formula, researchers used multiple regression analysis to examine the effects on district expenditure per pupil of each district's average family income and of the composition of the property tax base. Also studied were the effects of federal aid, state foundation and categorical aid, attendance (average daily membership), geographic area, proximity to the state limit on property tax rates, price of the county's agricultural land, the ratio of nonpublic school enrollment to population, and a number of other factors. Data on income were from 1969, while data on other variables were from the three fiscal years 1973-76. Results indicate that the percentage of nonagricultural land is related to expenditure per pupil. Results for income and for other variables, however, are either inconsistent or not significant, according to the authors. The effects of income and property tax base composition on expenditures are complex, they conclude. Two appendices explain the interpretation of the statistical analysis and suggest a way to develop a state aid formula weighted for income. (RW)

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PAPERS IN EDUCATION FINANCE

Paper No. 13

AN ANALYSIS OF POTENTIAL ADDITIONAL MEASURES OF FISCAL CAPACITY OF SOUTH DAKOTA SCHOOL DISTRICTS

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Prepared for the
Task Force on Alternative Measures of Wealth of the
South Dakota Division of Elementary and Secondary Education

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I. INTRODUCTION AND SUMMARY

In August of 1977, the Education Finance Center of the Education Commission of the States (ECS) was asked to examine how other elements of a school district's fiscal capacity in addition to the standard assessed value per pupil measure might play a role in the South Dakota state school aid formula. The proposed approach was to determine the relationships of average incomes of residents, property tax base composition and other factors with expenditures per pupil in the state. From this analysis, weighting factors for income and perhaps other fiscal variables for the school aid formula could be developed, if appropriate.

The findings from an analysis of available data for three fiscal years -- 1973-74, 1974-75, 1975-76 -- suggest that the influences of these factors on South Dakota school district spending are more complex than has been the case in other states. In general, the percentage of the property tax base composed of nonagricultural property has a positive influence on school district spending, both in total and out of locally raised revenues. However, the main issue of concern is the impact of income (specifically, median family income) on school spending. The results for income are not promising. The statistical results are not consistent across different years or for different formulations of the basic analytical model. In some instances, greater median family income in a district is associated statistically with lower spending per pupil.

A major problem in performing the analysis -- as was anticipated -- is that there are no solid data on family or per capita income by school district for the state since 1969, and even the U.S. Census data for 1969 income are suspect since they were estimated from census tracts that did not always follow school district boundaries. For the present study, county income data from the U.S. Department of Commerce's Survey of Current Business were used to estimate

median family income by school district for the years 1973 through 1975; this procedure probably results in important errors of measurement. Studies that have found positive and statistically significant impacts of income on school spending have either referred back to 1970 when better data were available or have utilized state income tax data where school districts are identified on tax return forms for tabulation.

Another possible explanation of this result is the rural nature of the South Dakota school system, particularly with the many very small schools, which probably results in rather high costs of operation in these more isolated areas. Such high costs, presuming they exist, are very hard to identify in a general statistical analysis of the present type. There may be very high costs of operation requiring high expenditures per pupil in many districts that have low average incomes.

On the other hand, there are caps on tax rates that may tend to be more in force in many districts where incomes are above average; taxpayers in these areas may actually be willing to spend more on schools than is allowed at present. The Census income data indicate that the highest income districts are those with relatively large enrollments located in the larger towns and cities.

In any case, the effect of income on spending for schools in South Dakota does not appear to be large either in the positive or negative direction. Implementation of an income factor based on the very limited statistical results that point in the presumably correct direction, however, could still give significant amounts of extra money to many lower-income school districts and take money away from higher-income districts.

Attempts were made to take into account the limitations on school districts from tax rate caps and necessary small schools, the latter presumably raising costs of operation well above average. Alternative approaches include the

following. A sophisticated analysis of the costs of producing education in the different districts of the state could be performed. This is a demanding task and must consider both the quality of the inputs purchased and, ideally, the outputs produced by the districts. This task is well outside the scope of the present study. But since a major difficulty lies in the accuracy of the income data itself, perhaps further study of an income factor should await the availability of much better income data. Such data should be available after the next census of population is performed in April 1980. Of course, the state legislature could implement a state income tax in the meantime and school districts could be identified by taxpayers. Given the intense feelings over whether or not to impose an income tax by the people of the state and their representatives in government, it is not likely that the need for better data on school districts' income will weigh very heavily in the debate over an income tax!

II. BASIC CONCEPTS AND APPROACH

The issue of measures of fiscal capacity other than property value per pupil for school aid formulas has been explored earlier by ECS staff (Odden, 1976). In fact, South Dakota was used as one of four sample states to indicate the influence of a significant income factor in reallocating state aid to a selected sample of different types of school districts -- city, suburban and rural. Table 1 indicates the impacts of a strong income factor in a basic, simple guaranteed tax base type of state aid formula, which should not be confused with the more complex combination of foundation plus guaranteed tax base plan adopted by South Dakota in 1977. The income factor used is a ratio, the numerator of which is the median family income of the school district and the denominator of which is the median family income of the state. Since the Rapid City and Sioux Falls districts were well above average in median family

TABLE 1

SIMULATED STATE AID FROM A GUARANTEED TAX BASE PROGRAM FOR SELECTED SCHOOL DISTRICTS IN SOUTH DAKOTA, 1974-75

	Simulated State Aid ($1,000s) Based on Equalized Assessed Value of Property per Pupil	Simulated State Aid ($1,000s) Based on Modified Equalized Assessed Value of Property per Pupil*
City School Districts		
Rapid City	$6,313	$5,126
Sioux Falls	6,464	3,239
Suburban School Districts		
Brandon Valley	587	341
Dell Rapids	213	105
Garretson	138	103
Hill City	164	140
Wall	0	0
West Central	440	336
Nonmetropolitan School Districts		
Aberdeen	2,206	1,406
Burke	85	101
De Smet	163	161
Harding County	0	0
Huron	1,491	1,026
McIntosh	68	84
New Effington	76	88
North Brown	123	141
Todd County	943	930
Watertown	1,614	1,323

*The property measure is multiplied by an income ratio, the numerator of which is the median family income of the school district and the denominator of which is the median family income of the state.

Source: Allan Odden. Alternative Measures of School District Wealth. Denver, Colorado: Education Commission of the States, December 1976, Tables 5, 6 and 7.

Prepared by the Education Finance Center, Education Commission of the States, for the Task Force on Alternative Measures of Wealth of the South Dakota Division of Elementary and Secondary Education.

income in 1969 (the year for which basic data were available), they would lose significant amounts of state aid with an income factor of this type under a pure guaranteed tax base plan. "Suburban" districts also generally had above average incomes in 1969 and also would tend to lose some aid. Mixed effects take place for the selected nonmetropolitan districts shown -- Burke and North Brown gaining nearly 20 percent in additional aid and Aberdeen and Huron County losing large amounts. Such a strong income factor is likely to be politically unpopular as well as not closely related to the importance of income in school spending in South Dakota.

More recently, a different approach to analyzing the role of income in district spending has been developed. For example, Ladd develops a statistical approach to school spending that attempts to separate out the effects of such factors as income, property value per pupil, the percentage of property value that is residential, the effective matching rate for state aid in a guaranteed tax base type of program, other state and federal aid and various other social and economic factors (1975). Currently, the authors are completing work for the National Institute of Education on a similar approach using the states of Colorado and Minnesota, which have sufficient data and a history of school finance reform.

The statistical approach employed by Ladd and most economists approaching this question is multiple regression analysis. That is, a dependent variable, here total or locally-financed expenditures per pupil, is related statistically to independent variables as indicated above such that the separate effects of each can be sorted out. Some factors are found to be "statistically significant," in that their relationships to school spending appear to be other than by chance, while others are not. In the case of income, Ladd finds that for a sample of Massachusetts school districts, a one percent increase in income will tend to

lead to around a 0.45 percent increase in school spending for the average district, assuming all other influences do not vary. In 1975, the median family income in South Dakota appears to have been somewhat over $11,000, while district spending averaged across districts was around $1,200 per pupil. If South Dakota districts behaved like those in Massachusetts, then a $110 increase in median family income (one percent) might lead to around a $6 increase in per pupil spending (0.45 percent). A very high income district, other factors assumed to be average, with a $16,000 median family income might spend $245 above the average for the state, if this income-spending relationship held constant for this large difference in income from the state average. Findings by the present authors for Colorado and Minnesota suggest that income differences among districts may be five to ten times stronger in their impacts on school spending than the results for Massachusetts indicate when applied to South Dakota.

Now such relationships between income and expenditures can be used in a more analytical way than previously to formulate a school aid formula that "neutralizes" income differences. That is, new school finance reforms, such as that recently passed in South Dakota, attempt to reduce significantly the connection between ability to spend on schools and local property tax wealth. But even when the property tax wealth impact is mitigated, two districts with the same property wealth per pupil and different incomes may be able to and may decide to spend different amounts. If we can determine the relationship of income and spending, if any, independently of any influences of property wealth and other factors, then we can design a scientifically-based "income factor." Details of such a means for adjusting state aid are given in Appendix B.

The difficulty that has arisen with calculating such a factor in South Dakota was noted in the Introduction: the statistical relationship between

income and spending is very difficult to sort out for a variety of reasons. In fact, in some instances where statistical tests were made on available data, the relationship between expenditures per pupil and the estimate of median family income appears to be negative across school districts for a given year. This result should not be confused with the obvious phenomenon over time that has occurred in the state in the past few years: falling per capita income due primarily to bad farm years together with rising school costs. One test of changes in school spending in relation to estimated changes in income and other explanatory variables was made.

III. RESULTS OF THE STATISTICAL ANALYSIS

For the interested reader, especially those more familiar with statistical techniques, the results of several regression equation estimates are presented in Appendix A. Estimates were made for three different years, 1973-74, 1974-75 and 1975-76, both for total (local plus state plus federal) and locally raised district revenues, in both "linear" and "logarithmic" form, the latter relating expenditures to explanatory variables in percentage rather than absolute terms, Also, a "first difference" estimate is presented in Table A-5 in Appendix A. The results are summarized below.

The independent relationship of income to total or district spending (actually revenues) per pupil varied from a decrease of $0.08 for each $1.00 increase in income in an average district to an increase of $0.001. A separate test for the effect of income alone on spending in 1973-74, based on the original 1969 income data, suggests that possibly an income increase of $1.00 could result in around a $0.01 (i.e., one cent) increase in school spending. Many of the estimated effects of income on spending are not "statistically significant." In any case, basing an income factor on these highly unstable results from weak income data would appear to rather tenuous at this time.

Other results found in the study are much more consistent and of some interest. The percentage of equalized assessed value of property that is nonagricultural plays a significant role in district spending. A one percentage point increase in this ratio (from a mean of 23 percent) leads to around $1.30 to $5.70 in additional spending per pupil. It is conceivable that a fiscal compensation factor similar to an income factor could be built upon this result. Areas of high percentages of nonagricultural property are, of course, the city and town districts that tend to have above average incomes. Thus, the impact of an adjustment factor based on this relationship would be in the same direction as compensating for low income. Actually it would tend to supplement the current policy of giving preferential treatment to predominantely agricultural school districts that now exists with the lower school property tax rate on agriculture. In fact, this finding for the role of nonagricultural property value may simply reflect this tax policy and could even account for statistical difficulties in obtaining a separate positive effect of income on spending.

The results for state and federal aid are rather interesting. A one dollar increase in state foundation aid appears to lead to an increase in total spending of from 70 to 90 cents across districts and a decrease in locally raised taxes of around 10 to 30 cents. Similarly, a one dollar increase in federal aid appears to result in an increase in total spending of around 70 to 90 cents and a decrease in locally raised taxes when looking across districts. Thus, these funds received from outside the district appear to result, in effect, in lower property taxes across districts at a given point in time. A more time-oriented view (see Table A-5), however, suggests that state foundation aid increases for any given district may result, over a two-year period, in <u>additional</u> locally-financed spending. State categorical aid is less likely to

be substituted for local dollars, it appears. In any case, aid flows do not appear to result in major property tax collection reductions, at least over the period studied.

Average daily membership (ADM) was tested in the statistical formulations presented in Appendix A both directly and as a squared term. The reason for this dual, more complicated entry was to make a rough test for economies of scale in school spending. An important problem in the type of expenditure analysis performed for this report is that we have no data on the quality of school district programs or on the true underlying costs of producing a given quality. In any case, the results for these tests of district ADM suggest that there may be a "U-shaped" average cost curve on average in the operation of South Dakota schools. Additional tests of the data indicate that the minimum of this curve could be at an ADM of around 15,000. A full-fledged geographic cost-of-education study sponsored by the state of Missouri, which did attempt to take into account quality and many other factors, suggests that the least cost pupil-size of a school district is around 2,500 pupils (Chambers, Odden and Vincent, 1976). In any case, these results suggest that greater economic efficiencies may be achievable by further consolidation of many very small school districts.

In an attempt to account for some aspects of differential geographic costs of education across the state, three variables were tested for their effects. ADM per classroom unit was found to have a significant negative effect across districts. This variable may relate to the necessity of providing high-cost classes for small groups of students in relatively isolated schools and districts. Across districts, it was found to have a statistically significant negative effect on spending, i.e., sparse, isolated areas do appear to have higher expenditures per pupil.

The price of agricultural land as estimated by county in 1974 by the Department of Agriculture is seen as related to basic costs of living; but it

was not found to be statistically significant. The number of school districts per square mile in a county has been suggested an an indicator of the degree of competition for teachers in regions of the state, but also was not found to be a significant factor in exploring expenditure variation across districts in South Dakota.

A variable for whether or not school districts were at the state-mandated limit on property tax rates for schools (40 or 50 mills) appears in each equation. It is highly significant and positive as expected. This variable was expected to allow for the possibility of higher wealth and income districts not being able to spend as much as they wished, but apparently this is not a key barrier to any wealth-income-expenditure relationship in the state. The main conclusion seems to be that higher tax rate, as well as higher property wealth, districts are in fact higher spending districts.

The equations presented in Appendix A indicate that the ratio of nonpublic school enrollment to population does not have a significant impact on public school spending, on average, in the state. Other variables were also tested in other equation forms that are not reported here. Specifically, median school years of the adult population, percentage of pupils who are nonwhite, pupil growth or decline rate of the district and ADM per square mile were found to have either no significant independent effect or were correlated highly with one of the above discussed factors (e.g., median years of schooling of the adult population was correlated with median family income).

It is once again emphasized that the results of the statistical analysis are far from conclusive on the role of income in South Dakota school spending, and the basic data on income by district are out of date and basically weak.

IV. CONCLUSION AND RECOMMENDATIONS

Lack of data at several levels has prevented a reasonably conclusive examination of the role of income in measuring school district fiscal capacity. Thus, the results and income factor calculated in Appendix B should be treated with caution. On the other hand, several interesting relationships between fiscal capacity, aid and other variables have been determined from the available data. Perhaps the best approach to the fiscal capacity issue at this time is to develop better data and work the basic analysis when these data are available.

There appears to be no readily available way to overcome the problem of weak income data at this time. One approach to this problem that was considered by the authors was to perform the analysis only at the county level where Survey of Current Business income per capita estimates could be used directly. But this approach would raise other problems. First, one would have to aggregate school districts, and some school districts lie in more than one county. Furthermore, in applying an income factor to particular districts one would have to apply the factor to the countywide income for that district. It is clear from the 1969 median family income data for school districts that there are wide variations in average income among school districts within many counties.

Given the problems of developing good income data, it may be wise to wait until the 1980 census results on income by school district are available (perhaps by late 1980 or early 1981) and then replicate the present type of analysis. Of course, if the legislature should ever decide to pass an income tax, there would be an opportunity to collect data on adjusted gross income per return by school district. Such data seems imperative in implementing an acceptable income factor in the school aid formula, such as was done in Missouri starting in the 1977-78 school year. In any case, the relatively high

volatility of income in South Dakota may indicate a need to have a moving average of, say, three years of income.

Another fiscal capacity issue that has received much attention recently is the percentage distribution ("composition") of the property tax base. In particular, the focus has been on the percentage of the property tax base that is residential versus industrial, commercial or agricultural. In the present study, the only related data available by school district was for agricultural versus nonagricultural, since agricultural property is explicitly taxed lower for school purposes in South Dakota, However, conversations with the State Secretary of Revenue indicate that a finer categorization of property types could be produced for school districts from existing data sources. A fairly detailed categorization of property-type values is now reported by county (Department of Revenue, 1975).

Other studies have indicated that the higher the percentage of residential property value in a district, other things equal the lower will be expenditures per pupil (Ladd, 1975; Feldstein, 1975). Some have argued that compensation similar to an income factor should be made through the state aid formula. Property tax relief to the residential sector might be channeled through this mechanism. Of course, many states have implemented direct property tax "circuit breakers" for aged and/or poorer homeowners and renters through income tax credits or direct payments. Minnesota and Wisconsin among other states, have highly developed circuit breaker programs. California is now considering "split roll" taxation to reduce property taxes on residential property -- much in the way that South Dakota taxes agricultural property less. (The present authors are in the midst of a major study for the California State Department of Education on the fiscal capacity and split roll issues -- together with geographic cost-of-education and tax analysis studies.)

In sum, the issue of what elements and what weightings to include as fiscal capacity measures in school aid formulas is important. Even when much greater equalization ("neutralization") for differing local district property tax bases has been achieved as in the new South Dakota school finance formula, there remains the difficulty of the low median family income districts that may be able to spend lesser amounts on schools than higher income districts. But without accurate, current income data, it is difficult to develop a basis for an analytically-based income factor. Naturally, a factor can be "pulled out of the air" -- as is the case for the ratio formula used to illustrate the impact of income factors in the earlier-noted ECS study (Odden, 1976). But there would remain the difficulty of establishing an accurate income number for each school district to apply to whatever income factor value or formula is chosen.

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APPENDIX A

INTERPRETATION OF STATISTICAL ANALYSIS

The formal statistical approach used to develop the numerical results discussed in the text is termed "multiple regression analysis." Although the term may be mysterious and forbidding to someone not familiar with formal statistical analysis -- and indeed the underlying mathematics used to develop the technique and the actual use of it with a computer are formidable -- the interpretation of the resulting equations is fairly straightforward.

A basic rationale of formal statistics is to sort out apparent relationships of different factors, to sort out those associations that are more by chance from those where there may be true causal relationships. For example, when the national speed limit was reduced from 65 to 55 m.p.h. in the name of saving energy, it was found that the accident rate also fell. There is certainly much evidence that higher speed leads to more accidents, but at the outset of the new law, automobile driving also fell off greatly due to scare supplies of gasoline and economic recession. What are the true causal factors for the lower accident rate? Formal statistical procedures can give supporting evidence one way or the other. By testing the accident rate against the change in the speed limit as well as decreased miles driven and other possible explanatory factors, we may be able to sort out what may have occurred by chance as well as the quantitative importance of those associations of explanatory factors that are unlikely to have been by chance.

One of the more important statistical techniques used by economists and others who do not usually engage in controlled experiments is called multiple regression analysis. Although there are many variations on this technique, the basic formulation used here assumes that there is some fiscal variable, e.g.,

school district expenditures per pupil, that is probably affected in different degrees by a variety of other fiscal, economic or demographic factors. For example, one might expect higher levels of median family income in a district to result in higher levels of spending. Likewise, higher state aid per pupil should result in higher levels of total spending by the district. In fact, one should set up a "theory" of what influences spending by a district, in terms of observable data, and then collect actual numbers to check to see if the theory is correct. This essentially is what has been done in this report.

The basic relationship between spending and such variables that is specified below is a "linear" algebraic equation. That is, we will assume that total revenues per pupil is equal to a sum of terms on the right hand side of the equation based on various explanatory factors. For example, we can write out algebraically:

Total Revenues per ADM = A + B x Median Family Income + C
x State Foundation Aid per ADM

When a statistical analysis is performed assuming this relationship, that expenditures depend on ("are a function of") property value and state aid, actual data for each school district ("an observation") are collected on each of the three variables. The mathematical manipulation of the data (requiring a modern-day computer) for all 195 school districts in South Dakota results in actual numbers for the "coefficients" of the above equation, A, B and C. That is, we obtain something like:

Total Revenues per ADM = \$676 + \$0.201 (Median Family Income)
+ \$0.870 (State Foundation Aid per ADM)

These results can be interpreted as follows. Hypothetically, even if there were zero median family income and state aid in a district, spending per child would tend to be \$676 per child (the "constant term" in the equation). But for each dollar that median family income rises, educational spending per pupil will tend

to rise 0.1 cents and for each dollar that state aid rises -- independently of the effect of median family income -- educational spending per pupil will tend to rise 87.0 cents (As discussed in the text, for this estimate the rest of the state aid would appear to go back to residents of the school district.). Now these coefficients do not mean that every school district will behave in exactly this way -- some may spend more and some less than 87 cents out of an extra dollar of state aid -- but on average this will tend to be the case.

Tables A-1 through A-5 give the results of several regression equations estimated from several years of South Dakota data. The equations have been presented vertically down the columns with the explanatory variables listed at the left for convenience. Two other items appear in this lsiting that must be explained in addition to the coefficients of the regression equation. Below each coefficient, except the constant term, is a number in parentheses. This number is the "t-statistic" that is used to help judge whether the variable is in fact "statistically significant," i.e., whether the particular coefficient value can be relied upon as being reasonably close to the true value. In the present case the t-statistic must be greater than 1.67 to be able to have at least 95 percent confidence that the regression coefficient is relatively accurate; a minimum value of 1.30 is necessary for 90 percent confidence. These figures help guide the use of the coefficients listed in the tables. Also, at the bottom of each of the two equations, there is a term, "R^2 = ." For the first equation in Table A-1, R^2 = 0.84, which means that 84 percent of the variation in total revenues per ADM of South Dakota school districts in 1973-74 has been explained by the above 13 factors, leaving 16 percent of the variation due to unidentified factors or to chance ("random") variation in behavior of school districts and their decision-makers.

TABLE A-1

TOTAL REVENUES AND DISTRICT REVENUES PER ADM FISCAL RESPONSE COEFFICIENTS FOR SOUTH DAKOTA, 1973-74 (1969 INCOME DATA)[a]

	Linear Equation Forms		Log (Elasticity) Equation Forms	
Determining Variables	Total Revenues Per ADM	District Revenues Per ADM	Total Revenues Per ADM	District Revenues Per ADM
Constant Term ($/ADM)	$342.045	$342.092	5.863	- 2.388
Median Family Income in 1969 ($/Family)	-$ 0.000 (0.055)	-$ 0.000 (0.045)	- 0.012 (0.207)	+ 0.045 (0.881)
Percent of Equalized Assessed Property Value that is Nonagricultural	+$ 1.301 (2.333)	+$ 1.296 (2.354)	- 0.029 (1.274)	+ 0.123 (6.100)
Equalized Assessed Value of Property ($/ADM)	+$ 0.014 (19.391)	+$ 0.014 (22.217)	+ 0.116 (3.738)	+ 0.810 (29.105)
State Foundation Aid ($/ADM)	+$ 0.852 (5.765)	-$ 0.146 (0.991)	- 0.002 (0.230)	- 0.006 (1.006)
State Categorical Aid ($/ADM)	+$ 1.005 (2.501)	+$ 0.000 (0.000)	+ 0.131 (3.222)	+ 0.014 (0.382)
Total Federal Aid ($/ADM)	+$ 0.736 (13.339)	-$ 0.265 (4.834)	+ 0.004 (1.265)	- 0.007 (2.371)
ADM (Thousands)	-$ 19.939 (1.237)	-$ 19.943 (1.242)	- 0.034 (1.829)	- 0.004 (0.221)
$(ADM)^2$ (Millions)	+$ 0.658 (0.727)	+$ 0.662 (0.736)	--- ---	--- ---
Nonpublic Enrollment to Population Ratio	+$ 1.403 (0.572)	+$ 1.408 (0.575)	+ 0.005 (1.376)	+ 0.004 (1.130)
ADM Per Classroom Unit	-$ 2.508 (1.790)	-$ 2.512 (1.802)	- 0.096 (1.692)	- 0.101 (2.004)
Price of Agricultural Land in County, 1974 ($/Acre)	+$ 0.072 (0.506)	+$ 0.073 (0.517)	- 0.048 (1.029)	+ 0.014 (0.349)
Districts Per Square Mile in County	+$ 5.724 (0.730)	+$ 4.939 (0.721)	- 0.042 (0.943)	+ 0.088 (2.218)
At District Tax Rate Upper Limit (Dummy Variable: 1 - Yes; 0 - No)	+$ 55.831 (3.404)	+$ 55.910 (3.428)	+ 0.058 (2.300)	+ 0.098 (4.302)
	R^2= 0.84	R^2= 0.84	R^2= 0.50	R^2= 0.88

[a] t-statistics are in parentheses below the regression coefficients. Variables of the predicted sign are statistically significant at the 90 percent level of confidence when the t-statistics are greater than 1.30 and at the 95 percent level of confidence when greater than 1.67.

Source: Based on a statistical analysis of data provided by the South Dakota Division of Elementary and Secondary Education and from the U.S. Bureau of the Census.

Prepared by the Education Finance Center, Education Commission of the States, for the Task Force on Alternative Measures of Wealth of the South Dakota Division of Elementary and Secondary Education.

TABLE A-2

TOTAL REVENUES AND DISTRICT REVENUES PER ADM FISCAL RESPONSE COEFFICIENTS FOR SOUTH DAKOTA, 1973-74[a]

	Linear Equation Forms		Log (Elasticity) Equation Forms	
Determining Variables	Total Revenues Per ADM	District Revenues Per ADM	Total Revenues Per ADM	District Revenues Per ADM
Constant Term ($/ADM)	$371.913	$372.093	5.624	- 2.090
Estimated 1973 Median Family Income	-$ 0.003 (0.875)	-$ 0.003 (0.873)	+ 0.019 (0.319)	+ 0.005 (0.084)
Percent of Equalized Assessed Property Value that is Nonagricultural	+$ 1.301 (2.375)	+$ 1.298 (2.370)	- 0.029 (1.313)	+ 0.125 (6.260)
Equalized Assessed Value of Property ($/ADM)	+$ 0.014 (18.991)	+$ 0.014 (19.004)	+ 0.111 (4.316)	+ 0.815 (28.608)
State Foundation Aid ($/ADM)	+$ 0.850 (5.779)	-$ 0.148 (1.007)	- 0.001 (0.209)	- 0.006 (1.077)
State Categorical Aid ($/ADM)	+$ 0.908 (2.183)	-$ 0.094 (0.226)	+ 0.134 (3.241)	+ 0.012 (0.329)
Total Federal Aid ($/ADM)	+$ 0.734 (13.438)	-$ 0.267 (4.881)	+ 0.004 (1.230)	- 0.007 (2.387)
ADM (Thousands)	-$ 18.754 (1.188)	-$ 18.727 (1.187)	- 0.035 (1.904)	- 0.001 (0.084)
$(ADM)^2$ (Millions)	+$ 0.607 (0.683)	+$ 0.609 (0.686)	--- ---	--- ---
Nonpublic Enrollment to Population Ratio	+$ 1.259 (0.512)	+$ 1.266 (0.517)	+ 0.005 (1.372)	+ 0.004 (1.207)
ADM Per Classroom Unit	-$ 2.450 (1.752)	-$ 2.454 (1.756)	- 0.097 (1.717)	- 0.102 (1.996)
Price of Agricultural Land in County, 1974 ($/Acre)	+$ 0.067 (0.476)	+ 0.068 (0.486)	- 0.048 (1.045)	+ 0.017 (0.399)
Districts Per Square Mile in County	+$ 5.441 (0.792)	+$ 5.351 (0.779)	- 0.042 (0.947)	+ 0.087 (2.179)
At District Tax Rate Upper Limit (Dummy Variable: 1 - Yes; 0 - No)	+$ 55.411 (3.413)	+$ 55.503 (3.421)	+ 0.057 (2.279)	+ 0.101 (4.473)
	R^2= 0.84	R^2= 0.84	R^2= 0.50	R^2= 0.88

[a] t-statistics are in parentheses below the regression coefficients. Variables of the predicted sign are statistically significant at the 90 percent level of confidence when the t-statistics are greater than 1.30 and at the 95 percent level of confidence when greater than 1.67.

Source: Based on a statistical analysis of data provided by the South Dakota Division of Elementary and Secondary Education and from the U.S. Bureau of the Census.

Prepared by the Education Finance Center, Education Commission of the States, for the Task Force on Alternative Measures of Wealth of the South Dakota Division of Elementary and Secondary Education.

TABLE A-3

TOTAL REVENUES AND DISTRICT REVENUES PER ADM FISCAL RESPONSE COEFFICIENTS FOR SOUTH DAKOTA, 1974-75[a]

	Linear Equation Forms		Log (Elasticity) Equation Forms	
Determining Variables	Total Revenues Per ADM	District Revenues Per ADM	Total Revenues Per ADM	District Revenues Per ADM
Constant Term ($/ADM)	$437.404	$437.818	6.826	- 1.529
Estimated 1974 Median Family Income	-$ 0.008 (2.293)	-$ 0.008 (2.289)	- 0.005 (0.089)	+ 0.028 (0.607)
Percent of Equalized Assessed Property Value that is Nonagricultural	+$ 2.519 (3.816)	+$ 2.515 (3.809)	- 0.049 (2.165)	+ 0.158 (7.774)
Equalized Assessed Value of Property ($/ADM)	+$ 0.015 (17.429)	+$ 0.015 (17.412)	+ 0.055 (1.765)	+ 0.752 (27.005)
State Foundation Aid ($/ADM)	+$ 0.870 (5.302)	-$ 0.131 (0.798)	- 0.002 (0.234)	- 0.010 (1.614)
State Categorical Aid ($/ADM)	+$ 0.917 (2.582)	-$ 0.080 (0.226)	+ 0.133 (3.123)	+ 0.017 (0.458)
Total Federal Aid ($/ADM)	-$ 0.780 (13.878)	-$ 0.220 (3.914)	+ 0.005 (1.663)	- 0.006 (2.144)
ADM (Thousands)	-$ 10.135 (0.546)	-$ 10.155 (0.547)	- 0.013 (0.683)	- 0.007 (0.402)
$(ADM)^2$ (Millions)	-$ 0.095 (0.089)	-$ 0.094 (0.089)	--- ---	--- ---
Nonpublic Enrollment to Population Ratio	+$ 0.112 (0.045)	+$ 0.091 (3.914)	+ 0.005 (1.277)	+ 0.005 (1.513)
ADM Per Classroom Unit	-$ 4.955 (2.682)	-$ 4.953 (2.681)	- 0.205 (3.318)	- 0.165 (2.998)
Price of Agricultural Land in County, 1974 ($/Acre)	+$ 0.209 (1.313)	+$ 0.210 (1.318)	- 0.029 (0.632)	+ 0.017 (0.405)
Districts Per Square Mile in County	+$ 0.589 (0.077	+$ 0.490 (0.063)	- 0.076 (1.670)	+ 0.061 (1.546)
At District Tax Rate Upper Limit (Dummy Variable: 1 - Yes; 0 - No)	+$ 88.108 (4.798)	+$ 88.244 (4.804)	+ 0.067 (2.545)	+ 0.116 (4.966)
	R^2= 0.83	R^2= 0.81	R^2= 0.49	R^2= 0.87

[a] t-statistics are in parentheses below the regression coefficients. Variables of the predicted sign are statistically significant at the 90 percent level of confidence when the t-statistics are greater than 1.30 and at the 95 percent level of confidence when greater than 1.67.

Source: Based on a statistical analysis of data provided by the South Dakota Division of Elementary and Secondary Education and from the U.S. Bureau of the Census.

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TABLE A-4

TOTAL REVENUES AND DISTRICT REVENUES PER ADM FISCAL RESPONSE COEFFICIENTS FOR SOUTH DAKOTA, 1975-76[a]

Determining Variables	Linear Equation Forms: Total Revenues Per ADM	Linear Equation Forms: District Revenues Per ADM	Log (Elasticity) Equation Forms: Total Revenues Per ADM	Log (Elasticity) Equation Forms: District Revenues Per ADM
Constant Term ($/ADM)	$676.307	$676.175	6.077	- 1.783
Estimated 1975 Median Family Income	-$ 0.008 (1.804)	-$ 0.008 (1.802)	+ 0.015 (0.292)	+ 0.026 (0.545)
Percent of Equalized Assessed Property Value that is Nonagricultural	+$ 2.730 (4.029)	+$ 2.735 (4.040)	- 0.048 (2.063)	+ 0.124 (5.917)
Equalized Assessed Value of Property ($/ADM)	+$ 0.014 (15.427)	+$ 0.014 (15.436)	+ 0.105 (3.127)	+ 0.772 (25.707)
State Foundation Aid ($/ADM)	+$ 0.684 (5.038)	-$ 0.317 (2.333)	- 0.003 (0.462)	- 0.004 (0.663)
State Categorical Aid ($/ADM)	+$ 0.954 (3.142)	-$ 0.045 (0.148)	+ 0.099 (2.251)	+ 0.013 (0.329)
Total Federal Aid ($/ADM)	+$ 0.771 (11.598)	-$ 0.229 (3.445)	+ 0.008 (2.333)	- 0.005 (1.782)
ADM (Thousands)	-$ 10.200 (0.480)	-$ 10.362 (0.488)	- 0.032 (1.778)	- 0.003 (0.184)
$(ADM)^2$ (Millions)	+$ 0.062 (0.045)	+$ 0.069 (0.055)	--- ---	--- ---
Nonpublic Enrollment to Population Ratio	+$ 1.157 (0.378)	+$ 1.121 (0.366)	+ 0.008 (1.853)	+ 0.004 (1.034)
ADM Per Classroom Unit	-$ 14.286 (3.250)	-$ 14.298 (3.255)	- 0.098 (2.591)	- 0.048 (1.420)
Price of Agricultural Land in County, 1974 ($/Acre)	+$ 0.132 (0.769)	+$ 0.132 (0.774)	- 0.048 (0.983)	- 0.019 (0.432)
Districts Per Square Mile in County	+$ 6.360 (0.752)	+$ 6.358 (0.752)	- 0.037 (0.797)	+ 0.093 (2.219)
At District Tax Rate Upper Limit (Dummy Variable: 1 - Yes; 0 - No)	+$ 84.615 (4.956)	+$ 84.646 (4.961)	+ 0.058 (2.503)	+ 0.110 (5.272)
	R^2= 0.88	R^2= 0.86	R^2= 0.58	R^2= 0.87

[a] t-statistics are in parentheses below the regression coefficients. Variables of the predicted sign are statistically significant at the 90 percent level of confidence when the t-statistics are greater than 1.30 and at the 95 percent level of confidence when greater than 1.67.

Source: Based on a statistical analysis of data provided by the South Dakota Division of Elementary and Secondary Education and from the U.S. Bureau of the Census.

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TABLE A-5

CHANGE IN TOTAL REVENUES AND DISTRICT REVENUES PER ADM FISCAL RESPONSE COEFFICIENTS FOR SOUTH DAKOTA, 1975-6 LESS 1973-4[a]

Determining Variables	Linear Equation Form: Total Revenues Per ADM	Linear Equation Form: District Revenues Per ADM
Constant Term	$ 59.631	$ 59.493
Estimated Median Family Income	+$ 0.001 (0.225)	+$ 0.001 (0.222)
Percent of Equalized Assessed Property Value that is Nonagricultural	+$ 5.669 (1.903)	+$ 5.645 (1.895)
Equalized Assessed Value of Property ($/ADM)	+$ 0.014 (14.100)	+$ 0.014 (14.098)
State Foundation Aid ($/ADM)	+$ 1.182 (5.660)	+$ 0.177 (0.847)
State Categorical Aid ($/ADM)	+$ 2.538 (7.675)	+$ 1.540 (4.292)
Total Federal Aid ($/ADM)	+$ 0.885 (10.383)	-$ 0.116 (1.356)
ADM (Thousands)	-$207.933 (2.542)	-$207.659 (2.539)
ADM Per Classroom Unit	+$ 4.385 (2.884)	+$ 4.372 (2.876)
At District Tax Rate Limit (Dummy Variable: 1 - Yes; 0 - No) (Not Differenced)	+$ 43.927 (2.899)	+$ 43.936 (2.900)
	R^2= 0.74	R^2= 0.63

[a]t-statistics are in parentheses below the regression coefficients. Variables of the predicted sign are statistically significant at the 90 percent level of confidence when the t-statistics are greater than 1.30 and at the 95 percent level of confidence when greater than 1.67.

Source: Based on a statistical analysis of data provided by the South Dakota Division of Elementary and Secondary Education and from the U.S. Bureau of the Census.

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APPENDIX B

DEVELOPMENT OF A WEIGHTING FACTOR FOR INCOME

In Appendix A above, a general discussion was given of the regression equations used to estimate the effect of median family income and other factors on school district spending in South Dakota. There is a fairly simple way to use the results of that analysis to develop an income factor to compensate low-income districts through additional state aid. The factor as developed here also will result in aid being reduced for relatively high-income districts from what it otherwise would be. Modifications can be made, of course, such that low-income districts receive increased aid, but high-income districts do not incur reduced aid.

Taking the simple equation developed for explanatory purposes in Appendix A, we have:

Total Revenues per ADM = A + B x Median Family Income + C
x State Foundation Aid per ADM

We can then set as a hypothetical goal that every district in the state should be able to spend equal amounts per pupil, if they choose to do so. We can then consider any two districts, call them District 1 and District 2, and assume that they make equal expenditures per pupil (have equal Total Revenues per ADM). What state aid differentials could make up for the actual income differentials of these two districts?

We can write out our assumption ("goal") of equal revenues per pupil and then do a little algebraic manipulation to come up with a simple income factor for modifying state aid:

Total Revenues per ADM in District 1 = Total Revenues per ADM in District 2

Then substituting on each side for the explanatory equation written above, using

the desired level of aid for each district to neutralize for the income differences, we can write:

A + B x State Foundation Aid per ADM in District 1 + C x Median Family Income in District 1

= A + B x State Foundation Aid per ADM in District 2 + C x Median Family Income in District 2

This equation can be solved for the "aid differential" to yield:

(State Foundation Aid per ADM in District 1 - State Foundation Aid in District 2 = (C ÷ B) x (Median Family Income in District 2 - Median Family Income in District 1)

That is, the "income factor" in this case is (C ÷ B), the regression coefficient for median family income divided by the regression coefficient for state foundation aid per pupil in explaining expenditures per pupil.

This result is used in the following manner to get aid differential results for each district in the state. Take District 1 median family income to be the state average across districts. Then District 2 is any particular district in the state. If District 2 has a median family income below the state average, then the income differential is negative. Multiplying this differential by (C ÷ B), which is assumed to be positive, yields a negative value for the hypothetical difference between state foundation aid in the first district (the "average district") and the second, below-average-income district. But this means that the second district should get this much more aid per pupil than the hypothetical average district. The aid differential in the above equation could be positive, but this is interpreted as meaning that this much aid per pupil would be taken out of the aid calculated normally for an above-average-income district on the basis of district property value per pupil -- and any other formula element such as pupil weightings.

To illustrate a positive factor drawn from the various regressions that were run, assume the regression coefficient for median family income is 0.001 ("C" in the above illustration) and the regression coefficient for state foundation aid per ADM is 0.900 ("B" in the above illustration). Thus, the income factor would be 0.001 (0.001 ÷ 0.900). That is, the differences in median family income from the statewide district average would be multiplied by the income factor to produce an estimate of how state foundation aid per pupil would change for each district under the existing formula. The total cost to the state government of implementing such an income factor would likely be negative. This reduction is due to the fact that the above average income districts in the state have many more pupils in total than the below-average income districts.

Income factors have been calculated from related preliminary research for Missouri and Minnesota. These tend to be much higher than the above factor calculated for South Dakota from such weak results, ranging from 0.019 to 0.105, a multiplicative difference of from 20 to 100 times that suggested here for South Dakota.

An actual simulation of an income factor's impact has not been made for this paper due to the lack of dependable data for and results from the statistical analysis for income. An example of such a simulation was done for the earlier draft and can be obtained from the authors.